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Monetary Policy and Unemployment in Open Economies

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Abstract

After an expansionary monetary policy shock employment increases and unemployment falls. In standard New Keynesian models the fall in aggregate unemployment does not affect employed workers at all. However, Lüchinger, Meier and Stutzer (2010) found that the risk of unemployment negatively affects utility of employed workers: An increases in aggregate unemployment decreases workers' subjective well-being, which can be explained by an increased risk of becoming unemployed. I take account of this effect in an otherwise standard New Keynesian open economy model with unemployment as in Galí (2010) and find two important results with respect to expansionary monetary policy shocks: First, the usual wealth effect in New Keynesian models of a declining labor force, which is at odds with the data as highlighted by Christiano, Trabandt and Walentin (2010), is shut down. Second, the welfare effects of such shocks improve considerably, modifying the standard results of the open economy literature that set off with Obstfeld and Rogoff's (1995) redux model.

Keywords: Open economy macroeconomics, monetary policy, unemployment

JEL classification: E24, E52, F32, F41

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1 Introduction

When a central bank embarks on an expansionary monetary policy, it does so to stimulate the domestic economy and reduce unemployment: A reduced real rate of interest results in an increase in output and employment while unemployment falls. The main motivation for such a policy stance is a societal preference for low levels of unemployment which entails both considerable psychological and fiscal costs. The psychological costs are borne mainly by the unemployed but also by those who still have a job as was shown with German, European and US data by Lüchinger, Meier and Stutzer (2010; LMS henceforth). In this paper I will shed light on two implications of this psychological effect of unemployment when introduced into an otherwise standard New-Keynesian open economy business cycle model. The first implication is the reaction of the labor force to expansionary monetary policy shocks. Standard New Keynesian models fail to replicate the stylized fact of an increase in labor market participation in response to monetary or other demand shocks while the modified model presented here can explain it. The second implication is the welfare effect of monetary policy shocks in the tradition of the Obstfeld and Rogoff (1995) open economy redux model. The modified model allows for considerable welfare improvements relative to those in standard models.

The psychological effects of unemployment are introduced as a negative externality of aggregate unemployment on workers' well-being. The aggregate unemployment rate is related to workers' disutility from work, acting as an endogenous preference shifter that reduces disutility of work when unemployment falls. This modification of an otherwise standard utility function is motivated by the finding in LMS that an increase in unemployment negatively affects the subjective well-being of people who still have a job. LMS explain this, inter alia, by an increase in currently employed workers' perception of themself being affected by unemployment in the future. Unemployment thus exerts insecurity in the workplace and thereby reduces utility of those workers who are currently employed. Furthermore, workers who want to be employed, i.e. those who are unemployed and those considering to participate in the labor market or not, are affected by the preference shifter as well.

The modified utility implies that the labor force, and not only employment, increases after an expansionary monetary policy shock. This is a stylized fact highlighted by Christiano, Trabandt and Walentin (2010; CTW henceforth) and which is at odds with predictions of standard New Keynesian models where the wealth effect both increases consumption and desired leisure thus decreasing the labor force. The intuition for the positive correla-

tion between employment and the labor force in the model presented below is as follows: The lower real interest rate after the shock induces an increase in consumption and employment and a decrease in unemployment.[1] The lower unemployment rate, in turn, reduces the disutility from work for any given level of employment which increases the incentive to join the labor force. In other words, the labor force grows when unemployment falls. The usual wealth effect that increases consumption and reduces the supply of labor after an expansionary monetary policy shock which caused the standard New Keynesian models' failure to replicate the stylized fact is simply shut down.

CTW, Galí (2011) and Galí, Smets and Wouters (2011) addressed this problem in closed-economy frameworks in different ways. CTW assume incomplete risk sharing in consumption and search effort needed to find a job such that an unemployed worker is always worse off than an employed worker. As a result, an expansionary monetary policy shock induces inactive workers to join the labor force as demand for labor increases and thereby the expected utility of being in the labor force rather than out of it. Galí (2011) and Galí et al. (2011) shut down the wealth effect by employing a preference shifter that is determined by the deviation of aggregate consumption from its long-run growth path. This approach is, of course, closely related to the one pursued in this paper as a fall in unemployment is correlated with an increase in aggregate consumption. However, the reasoning above of a psychological effect of aggregate unemployment on individual well-being following LMS provides a reasonable microfoundation for a modification of utility.

The second implication relates to the open economy dimension of the model and the normative implications of monetary policy shocks. With unemployment affecting utility directly, the welfare effects of monetary policy change considerably compared to prior research. In particular, I show that in this model the welfare effects are much more beneficial than in previous work and even changing signs for reasonable calibrations. This work is now briefly summarized as it provides the reference point for the following analysis.

Obstfeld and Rogoff (1995) showed that when the elasticity of substitution between domestically produced goods (henceforth the within-country substitutability) equals the elasticity of substitution between domestic and foreign goods (henceforth the cross-country substitutability), utility (i.e. welfare) increases after an expansionary monetary policy shock both for the domestic and the foreign representative household. The welfare measure employed was the discounted present value of utility changes after the shock. Corsetti and Pesenti (2001) and Tille (2001) showed that this result is not robust to calibrations where the cross-country substitutability is lower than the

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[1]I will motivate the effect on employment, rather than hours worked per worker, below.

within-country substitutability. Domestic welfare falls while foreign welfare increases implying a beggar-thyself effect of monetary policy shocks.

These last results with respect to welfare are due to the interaction of short-run and long-run effects of the shock and these are changed by the modified utility. In the standard model, a high cross-country substitutability implies a strong positive reaction of output in the short-run due to a strong expenditure switching effect which increases disutility of work and resulting in a short-run fall in utility. As capital markets are integrated but incomplete, the export revenues that are temporarily higher than in the steady state imply a permanent transfer of wealth in favor of the domestic economy. In the new steady state this allows higher consumption and less hours of work than in the original steady state, long-run welfare thus increases which dominates the short-run effect in Obstfeld and Rogoff (1995). When the cross-country substitutability is reduced, both the short-run and the long-run effects are reduced. Engler and Tervala (2011) showed that the negative short-run effect does not change sign while the long-run effect turns negative for a cross-country substitutability of smaller than one. As households discount the long-run effects, the short-run negative effect dominates such that overall welfare falls for a small cross-country substitutabilities. As unemployment falls when output increases, in the model presented below, the modified utility dampens the short-run negative welfare effect as the increase in employment is offset by the positive effect of reduced unemployment on utility. Overall welfare therefore increases for all values of the cross-country substitutability.[23]

The choice of producer currency pricing (PCP), but not local currency pricing (LCP) practices in this model is motivated by the recent findings of Bluedorn and Bowdler (2011). They find that a US expansion results in spillover effects that reduce other G7-countries' interest rates while for some of these countries the output responses are positive while for others they are negative. This last ambiguous effect can be explained by varying cross-country substitutabilities. LCP practices, in contrast, would not be in accordance with these findings.[4]

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[2]In New Keynesian closed economy models welfare increases in any case because of the monopolistically competitive market structure (see, for example Blanchard and Kiyotaki, 1987) so that the modified utility simply increases the increase in welfare.

[3]The precise model dynamics would be different in a model with multi-stage intra-industry trade where the cross-country substitutability matters less while direct demand effects for intermediate goods imports determine international trade as in Kevin Huang's and Zheng Li's (2007) paper. I thank Kevin to point this out to me. However, the effect of unemployment on utility would still improve the welfare effect of a monetary policy shock in the domestic economy while the outcome for the foreign economy would certainly be similar for a low cross-country substitutability.

[4]See Tervala (2011) for a discussion of the positive and normative implications of mon-

Employment, unemployment and fluctuations thereof are introduced as in Galí (2010). What is usually looked at when accounting for changes in total hours worked (and, implicitly, job market inactivity) is the change in total hours per worker. However, economy wide hours can be split up into changes in the number of hours worked per worker, the intensive margin, and changes in the number of workers, the extensive margin. At business cycle frequencies, the latter clearly dominates the first as was pointed out by Hansen (1985) for US data and more recently by Merkl and Wesselbaum (2011) for US and German data. It is thus rather people moving out of leisure or unemployment into employment than workers changing their number of hours that drive (as in real business cycle models) or go along with (as in Keynesian models) the business cycle. When interpreting fluctuations in total hours as fluctuations of employment, a link can be established between employment, the labor force and unemployment as was demonstrated by Galí (2010), extending the basic model of Erceg, Henderson and Levine (2000) of a closed economy. Unemployment is proportional to the wage markup and fluctuations in this markup due to nominal wage rigidities determine the rate of unemployment. A positive demand shock, like an expansionary monetary policy shock, then reduces the wage mark-up and the rate of unemployment.

This paper is structured as follows. In section 2 the literature on the link between unemployment and well-being is briefly introduced. In section 3 I present a New Keynesian two-country model with price and wage rigidities that incorporates unemployment as in Galí (2010). Within this framework I discusses the positive and normative implications of an expansionary monetary policy shock in section 4.

2   Unemployment and well-being

The standard macroeconomic approach to modelling the effects of labor market participation on well-being is to assume that hours worked reduce utility while aggregate unemployment does not affect utility at all. However, there is a large literature on the psychological effects of unemployment and job insecurity on well-being. In particular, there is evidence that unemployment does not only reduce the well-being of the directly affected but also of people who still have a job. Oswald (2003), for example, found that subjective well-being is inversely related to unemployment even after controlling for personal unemployment. In what follows I briefly shed light on this large literature on interpersonal spillover effects of job market experiences.

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etary policy shocks under LCP and PCP.

The most obvious transmission channel of labor market experiences between individuals is between spouses. McKee and Bell (1986) interviewed unemployed spouses in the English city of Kidderminster. They found that the (usually male) breadwinner's unemployment severely affected their partners' state of well-being as unemployment increased the budgetary constraints and dramatically reduced both partners' social ties with the outside world, i.e. outside their own household. But not only unemployment itself has effects on partners but also stress in the work place. Jones and Fletcher (1993) showed for English and Welsh cohabiting couples who worked either full or part-time, that men's work related stressors affected measures of their partners' anxiety and depression (but not vice versa from women to men). The psychological effects of both employment and unemployment thus have psychological repercussions within families.

Moreover, "job insecurity", i.e. the perception of one's job to become "redundant" some time in the future, was shown to be an important stressor for employees. Dekker and Schaufeli (1995) showed that job insecurity affected workers' well-being more than the actual redundancy. In the same vein de Witte (1999) showed in a study of employees of a Belgian plant of a European multinational company in the metalworking industry that the well-being of employees is affected negatively when the perception of losing one's job increases. This result also holds after controlling both for personal characteristics like occupational status, gender and age and for job characteristics like workload demands and a measure of skill utilization.

Apart from firm specific reasons determining the perception of job insecurity, another important factor could be other people's unemployment. When aggregate unemployment rises this could be viewed by employees as an indication that the likelihood of themselves being laid off increases. Consequently, unemployment could affect the perception of job insecurity and thereby well-being of people who are still employed because income and social status related to being employed would be lost in case of a layoff. The welfare and utility consequences of unemployment would then go beyond the directly affected.

Lüchinger et al. (2011) found evidence for this hypothesis of well-being being affected by aggregate unemployment through an effect on job insecurity with data from the German socio-economic panel (GSOEP). They found that reported life satisfaction is significantly and inversely related to regional unemployment across German states. Moreover, this effect is strongest for private sector employees, lower for public sector employees and non-existent for public servants ("Beamte"). This can be interpreted as evidence in favor of the above stated hypothesis of unemployment affecting job insecurity because German public servants can hardly be fired at all, while job protec-

tion is stronger for public sector employees than for private sector employees. These results were confirmed with US and European Union data from the General Social Survey and the Eurobarometer, respectively.

For macroeconomic modelling the question then arises whether these effects matter if properly taken account of. I will show that the stylized fact about the reaction of the labor force to monetary policy shocks mentioned in the introduction can be explained when this is done, in contrast to standard New Keynesian models. The model fit can thus be improved by modifying the utility function. Furthermore I show the welfare consequence of this modification for monetary policy shocks in an open economy.

3 The Model

The model is a New-Keynesian, two-country open economy model as in Engler and Tervala (2011) but with monopolistic competition in both the goods and the labor market and price and wage rigidities à la Calvo (1983) as in Erceg et al. (2000). Furthermore, unemployment is taken account of explicitly and determined by the mark-up prevailing in the labor market, i.e. the degree of monopolistic competition as in Galí (2010). Aggregate unemployment, in turn, feeds back into private disutility of labor and thereby affects the marginal rate of substitution, the labor supply decision and welfare. Capital markets are fully integrated but this market is incomplete as there is only trade in a riskless bond. Monetary policy is modelled as a standard Taylor rule.

3.1 Households

Home and foreign houeseholds determine goods demand functions and Euler equations given relative prices, the terms of trade, the exchange rate and a budget constraint while employment is determined by a labor union that sets wages under monopolistic competition taking account of firms' labor demand. Labor supply, in contrast, is determined by the hypothetical allocation under perfect competition in the labor market, given the real wage. The difference between the (log) labor supply and (log) employment determines the unemployment rate.

3.1.1 Preferences and goods demand

The world economy is populated by a continuum of households which in turn consist of a continuum of members. The fraction $1 - n$ of these households

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lives in the domestic economy while the remaining fraction n lives in the foreign country, so the size of the world economy is normalized to 1. Following Galí (2010), household members are represented by the pairs $(i; j) \in [0; 1] *$ $[0; 1]$ where index i represents the type of work an individual is specialized in and j represents the disutility from work. Each individual either works or is unemployed. When working, the disutility of work is j^φ with $\varphi > 0$ and zero when he is out of work.

I assume full risk sharing across individuals and households within countries so that the work status does not affect the level of consumption. An implication of this is that I abstract from any effects of unemployment on utility beyond its effect on the disutility from working.

The representative domestic household's objective function is the discounted present value of the infinite sequence of period utility functions,

$$E_0 \sum_{t=0}^{\infty} \beta^t V\left(C_t, \{N_t(i)\}\right) \tag{1}$$

with discount factor β, rational expectations operator E and period utility function

$$
\begin{aligned}
V\left(C_t, \{N_t(i)\}\right) &= \log C_t - \Theta_t \int_0^1 \int_0^{N_t(i)} j^\varphi \, dj \, di \\
&= \log C_t - \Theta_t \int_0^1 \frac{N_t(i)^{1+\varphi}}{1+\varphi} \, di
\end{aligned}
$$

where $N_t(i)$ is the fraction of household members with specilization i that is employed in period t, and Θ_t is an endogenous preference shifter defined as

$$\Theta_t \equiv \overline{\varkappa} \exp\left(u_t\right)^{\varkappa}$$

where u_t is the unemployment rate as defined below, $\overline{\varkappa}$ and $\varkappa$ are parameters determining the strength of the preference in and around the steady state, respectively. When unemployment falls, the marginal disutility from work falls. As outlined above, an intuitive explanation for this preference shifter is that some of the disutility from work derives from workers' stress implied by being afraid of losing their jobs because of unemployed workers standing ready to replace them. When unemployment falls, this stress is reduced and people feel less disutility at the workplace. Galí, Smets and Wouters (2011) employ a preference shifter that employs a time trend in consumption. There it is consumption temporarily growing faster than trend in a boom that induces a lower disutility from work.[5] As consumption growth will be strong

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[5]See also Jaimovich and Rebelo (2009) for a preference shifter in the context of news shocks driving the business cycle.

when unemployment is low, the underlying mechanism is indeed similar.[6]

The consumption index C_t is defined as

$$C_t = \left[(1-n)^{\frac{1}{\rho}} \left(C_t^h \right)^{\frac{\rho-1}{\rho}} + n^{\frac{1}{\rho}} (C_t^f)^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}$$

with

$$C_t^h = \left[(1-n)^{-\frac{1}{\theta}} \int_n^1 (C_t^h(z))^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}} , \ C_t^f = \left[n^{-\frac{1}{\theta}} \int_0^n (C_t^f(z))^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}},$$

where $C_t^h(z)$ and $C_t^f(z)$ are domestically or foreign produced goods z. I assume no home bias in consumption so that according indexes apply for the foreign economy. These equations, as most other foreign equations, will not be shown, however. A standard expenditure-minimization procedure produces demand functions for the continuum of goods,

$$C_t^h(z) = \left(\frac{P_t^h(z)}{P_t^h} \right)^{-\theta} \left(\frac{P_t^h}{P_t} \right)^{-\rho} C_t$$

$$C_t^f(z) = \left(\frac{P_t^f(z)}{P_t^f} \right)^{-\theta} \left(\frac{P_t^f}{P_t} \right)^{-\rho} C_t$$

with the aggregate consumption price index defined as

$$P_t \equiv \left[(1-n)(P_t^h)^{1-\rho} + n(P_t^f)^{1-\rho} \right]^{\frac{1}{1-\rho}} \tag{2}$$

and the price index of domestically and foreign prodced goods defined as

$$P_t^h \equiv \left((1-n)^{-1} \int_n^1 \left(P_t^h(z) \right)^{1-\theta} dz \right)^{\frac{1}{1-\theta}} \text{ and } P_t^f \equiv \left(n^{-1} \int_0^n \left(P_t^f(z) \right)^{1-\theta} dz \right)^{\frac{1}{1-\theta}}$$

respectively, where $P_t^h(z)$ and $P_t^f(z)$ are the prices corresponding to $C_t^h(z)$ and $C_t^f(z)$.

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[6]This micro-founded endogenous preference shifter also provides an alternative to the notion that certain recessions are caused by "a severe attack of contagious laziness", as Modigliani (1977) described the focus of some authors on an exogenous preference shifter associated with declinig employment. That the Great Depression in the 1930s, for example, was caused by a societal unwillingness to work is indeed implausible. However, an endogenous increase in disutility because of the increase in unemployment, is quite likely in light of the evidence presented above. In that case, the causality runs from unemployment to preferences and not vice versa.

The law of one price is assumed to hold, so we have

$$P_t^h(z) = S_t P_t^{*h}(z), \quad P_t^f(z) = S_t P_t^{*f}(z),$$

for foreign currency price $P_t^{*h}(z)$ of a domestically produced good and $P_t^{*f}(z)$ as the foreign currency price of a foreign produced good and nominal exchange rate S_t expressing the domestic currency in terms of the foreign currency. Because all goods are tradable and because of the absence of a home bias in consumption, purchasing power parity holds, i.e. $P_t = S_t P_t^*$ for the foreign consumption price index P_t^*.

As there are $(1-n)$ households in the home and n households in the foreign country, world demand for domestic and foreign goods then is given by

$$Y_t^d(z) = \left(\frac{P_t^h(z)}{P_t^h}\right)^{-\theta} \left(\frac{P_t^h}{P_t}\right)^{-\rho} C_t^W \tag{3}$$

where $Y_t^d(z) \equiv (1-n)C_t^h(z) + nC_t^{*h}(z)$ is world aggregate demand for good z with $C_t^{*h}(z)$ denoting foreign demand for the domestic good and where $C_t^W \equiv ((1-n)C_t + nC_t^*)$ is world aggregate consumption. The representative household's total spending on consumption in period t can be shown to be

$$\int_n^1 P_t^h(z)C_t^h(z)dz + \int_0^n P_t^f(z)C_t^f(z)dz = P_t C_t$$

3.1.2 The terms of trade and the nominal exchange rate

World demand for good z (equation 3) is a function of the relative price $\frac{P_t^h}{P_t}$. When approximated around the steady state, this term is proportional to the terms of trade T_t, defined as

$$T_t \equiv \frac{P_t^h}{P_t^f}$$

as an approximation of the consumer price index (2) around a symetric steady state in which $P^h = P^f$ can be shown to yield[7]

$$\widehat{p}_t^h - \widehat{p}_t = n\widehat{\tau}_t$$

Hats over lower case variables denote percent deviations from the respective steady state values. The link between the terms of trade and the nominal exchange rate can be established by using the law of one price so that

$$\widehat{\tau}_t = \widehat{p}_t^h - \widehat{p}_t^{*f} - \widehat{s}_t \tag{4}$$

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[7]The corresponding equation for the foreign economy is $\widehat{p}_t^* = \widehat{p}_t^{*f} + (1-n)\widehat{\tau}_t$.

To the extent that prices are sticky, a depreciation of the nominal exchange rate, i.e. $\widehat{s}_t > 0$, implies a deterioration of the terms of trade, i.e. $\widehat{\tau}_t < 0$.

3.1.3 Budget Constraints, Euler Equations and interest rate parity

When maximising (1), the household faces the flow budget constraint

$$D_t = (1 + i_t)D_{t-1} + \int_0^1 W_t(i)N_t(i)di - P_tC_t + \Pi_t \tag{5}$$

where i_t is the riskless non-state-contingent nominal interest rate of the domestic bond D_t, where Π_t is the household's share in firms' profits and where $W_t(i)$ is the nominal wage that type i workers receive when employed. The domestic bond is assumed to be traded internationally in a frictionless market. Foreign households' holdings of these bonds are D_t^* so that the market for the bond clears when

$$(1 - n)D_t + nD_t^* = 0$$

The resulting home Euler equation of the domestic household is

$$\frac{1}{1 + i_t} = \beta E_t \left\{ \frac{C_t}{C_{t+1}} \frac{P_t}{P_{t+1}} \right\}$$

while for the foreign household, when maximising with respect to a foreign bond that is not traded internationally and paying interest i_t^*, the Euler equation is

$$\frac{1}{1 + i_t^*} = \beta E_t \left\{ \frac{C_t^*}{C_{t+1}^*} \frac{P_t^*}{P_{t+1}^*} \right\}$$

Because of the integrated market for domestic bonds, domestic and foreign nominal interest rates are linked through an interest parity condition into which a risk premium is incorporated,

$$1 + i_t = (1 + i_t^*)E_t \left\{ \frac{S_{t+1}}{S_t} \right\} - \psi \left(e^{d_t} - 1 \right)$$

where d_t is the domestic international investment position relative to steady state GDP. I assume that in the steady state $D = 0$ so that the risk premium is zero in the steady state, too. The risk premium is introduced because otherwise the steady state would not be unique.[8]

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[8]A risk premium of this kind was proposed by Schmitt-Grohé and Uribe (2003) to

3.1.4 Wage setting

As workers are specialized in certain types of work in this model, it is reasonable to assume that they are not exposed to perfect competition in the labor market. Following Erceg et al. (2000) and Galí (2010), wage $W_t(i)$ is set by a labor union representing sector i workers in an environment of monopolistic competition. Labor input $N_t(i)$, on the other hand, is determined by firms' aggregate labor demand decisions and allocated equally across households within a country. Furthermore, a mechanism à la Calvo (1983) is assumed according to which wages in a sector can only be reset in a given period with probability $1 - \theta_w$ that is independent of the time since the last resetting occurred. This implies that it is optimal for the unions to set wages in a forward looking manner as they know that with a positive probability they will have to leave their wage unchanged in a changed future environment.

When deciding about the optimal wage W_t^o in period t, unions take as given the aggregate wage index $W_t = \left(\int_0^1 W_t(i)^{1-\epsilon_w} di \right)^{\frac{1}{1-\epsilon_w}}$ and domestic labor demand for period $t + k$, $N_{t+k|t}$,

$$ N_{t+k|t} = \left(\frac{W_t^o}{W_{t+k}} \right)^{-\epsilon_w} \int_n^1 N_{t+k}(z) dz $$

which is conditional on the wage decision in period t, as given. $N_{t+k}(z)$ is firm z's labor input explained in more details below. The first order conditions for optimal wages are thus

$$ \sum_{k=0}^{\infty} (\beta \theta_w)^k E_t \left\{ \frac{N_{t+k|t}}{C_{t+k}} \left(\frac{W_t^o}{P_{t+k}} - \frac{\epsilon_w}{\epsilon_w - 1} MRS_{t+k|t} \right) \right\} = 0 $$

where $MRS_{t+k|t} = C_t \Theta_t N_{t+k|t}^{\varphi}$ is the marginal rate of substitution between consumption and employment in $t + k$ for workers whose wages were reset in

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induce stationarity in a small-open economy model. See also Bergin (2006) for an empirical assessment and Tervala (2011) for a theoretical application. The reason why the risk premium ensures uniqueness of the steady state can be seen when we log-linearize the two Euler equations, subtract one from the other, take account of the purchasing power parity and the interest parity conditions, to get $\widehat{c}_t - \widehat{c}_t^* = E_t \left\{ \widehat{c}_{t+1} - \widehat{c}_{t+1}^* \right\} + \psi d_t$. Without a risk-premium (i.e. $\psi = 0$), temporary changes to the difference between domestic and foreign consumption, due to a re-allocation of wealth, would become permanent. Consumption and other variables would thus follow a random walk, a property that the new open economy models in the tradition of Obstfeld and Rogoff (1995) possess. An international investment position and a corresponding risk premium that return to their original steady states allow the difference in consumption to fade over time. A technical advantage of the absence of the random walk property is that it allows the computation of unconditional moments.

period t. Log-linearizing around the deterministic zero inflation steady state, we get

$$w_t^o = \mu^w + (1 - \beta\theta_w)\sum_{k=0}^{\infty}(\beta\theta_w)^k E_t\{mrs_{t+k|t} + p_{t+k}\} \tag{6}$$

where $\mu^w = \log\frac{\epsilon_w}{\epsilon_w - 1}$ is the log steady state (and frictionless) wage markup. In order to relate the wage setting decision in sector i to aggregate developments one can define $MRS_t = C_t\Theta_t N_t^\varphi$ as the average marginal rate of substitution with aggregate employment $N_t = \int_0^1 N_t(i)di$ and gets

$$
\begin{aligned}
mrs_{t+k|t} &= mrs_{t+k} + \varphi\left(n_{t+k|t} - n_{t+k}\right) \\
&= mrs_{t+k} - \epsilon_w\varphi\left(w_t^o - w_{t+k}\right)
\end{aligned}
\tag{7}
$$

Combining (6) and (7) with the linearized wage index $w_t = \theta_w w_{t-1} + (1 - \theta_w)w_t^o$ one obtains the wage inflation equation

$$\pi_t^w = \beta E_t\left\{\pi_{t+1}^w\right\} - \lambda_w\left(\mu_t^w - \mu^w\right) \tag{8}$$

where $\pi_t^w = w_t - w_{t-1}$ is the nominal wage inflation, where $\mu_t^w = w_t - p_t - mrs_t$ is the average wage markup and where $\lambda_w = \frac{(1-\theta_w)(1-\beta\theta_w)}{\theta_w(1+\epsilon_w\varphi)}$ is the responsiveness of the wage inflation to wage markup fluctuations.

Defining the log real wage as $\omega_t \equiv w_t - p_t$, the following identity linking the real wage and wage and CPI inflation holds:

$$\widehat{\omega}_t = \widehat{\omega}_{t-1} + \pi_t^w - \pi_t$$

3.1.5 Unemployment

Following Galí (2010), I now relate the inefficiently low level of employment that is due to the monopolistic labor market structure to the unemployment rate. This is done by determining the actual level of employment and the level of employment that would be observed in a world without monopolistic competition in the labor market. The latter of the two constitutes the aggregate labor force and the difference between the two the level of unemployment.

A worker with specilization i will be willing to work as long as the condition

$$\frac{W_t(i)}{P_t} \geqslant C_t\Theta_t j^\varphi$$

is fulfilled. For the "marginal supplier" in sector i, denoted as $L_t(i)$, this condition holds with equality:

$$\frac{W_t(i)}{P_t} = C_t\Theta_t L_t(i)^\varphi$$

Defining the aggregate labor force as $L_t = \int_0^1 L_t(i)di$, taking logs and integrating, we get the aggregate labor supply relation

$$w_t - p_t = c_t + \ln \overline{\varkappa} + \varkappa u_t + \varphi l_t \tag{9}$$

where $w_t = \int_0^1 w_t(i)di$, $l_t = \int_0^1 l_t(i)di$.

Defining the unemployment rate u_t as the (log) difference between the aggregate labor force and employment,

$$u_t = l_t - n_t$$

and using the wage markup equation,

$$\mu_t^w = w_t - p_t - (c_t + \ln \overline{\varkappa} + \varkappa u_t + \varphi n_t) \tag{10}$$

we get

$$\mu_t^w = \varphi u_t \tag{11}$$

The unemployment rate in period t is thus proportional to the wage markup. Any decline in the markup, due to a decline in the real wage or an increase in consumption or employment, will result in a decline in the unemployment rate as people move out of unemployment into work and out of the labor force into inactivity. The strength of this effect is determined inversely by the parameter φ which determines the degree of disutility of work. The driving force of ouput fluctuations in this model are employment fluctuations, i.e. the extensive margin, and not changes in hours worked per worker, the intensive margin, as in most standard New Keynesian models. The utility cost of an increase in output is determined by the disutility of being in work rather than out of work and not the disutility of reducing leisure to work more hours of an already employed worker.

Combining (8) and (11) results in a New Keynesian wage Phillips curve of the form

$$\pi_t^w = \beta E_t \left\{ \pi_{t+1}^w \right\} - \lambda_w \varphi \left(u_t - u^n \right) \tag{12}$$

where u^n is the natural rate of unemployment suggesting a negative correlation between unemployment fluctuations and wage inflation. This relationship resembles the original Phillips curve (Phillips, 1958) but differs from it in that it is microfounded, i.e. its parameters are derived from an optimization procedure so that the negative co-movement between unemployment and wage developments is explicable by economic theory rather than a pure statistical relationship. Furthermore, the curve is forward looking which was

also absent in the original formulation of Phillips. Galí (2011) shows that (12) describes US labor market developments in the time since the mid-1980 and in the post-war period until the early 1970s reasonably well.

The modification of the utility function affects the marginal rate of substitution and thereby the labor supply and employment decisions and consequently the unemployment rate. This can be seen in equations (9) and (10), respectively and will be discussed below in detail.

3.2 Supply Side: Firms

3.2.1 Profits and Demand

The continuum of domestic firms is indexed by $z \in [n,1]$, and produces output $Y_t(z)$ with production function

$$Y_t(z) = N_t(z)^{1-\alpha} \tag{13}$$

where $N_t(z) = \left(\int_0^1 N_t(i,z)^{1-\frac{1}{\epsilon_w}} di \right)^{\frac{\epsilon_w}{\epsilon_w - 1}}$ is the employment index of firm z. The firm's demand for labor input of type i, $N_t(i,z)$, is

$$N_t(i,z) = \left(\frac{W_t(i)}{W_t} \right)^{-\epsilon_w} N_t(z)$$

for all $i \in [0,1]$ and $z \in [n,1]$

Firm z period t profits are

$$\Pi_t(z) = P_t^h(z) Y_t(z) - W_t N_t(z), \tag{14}$$

which take account of world demand function (3) and production function (13).

3.2.2 Price Setting

Under flexible prices, home firm z's first order condition is

$$P_t^{ho}(z) = \frac{\theta}{\theta - 1} \frac{W_t}{(1-\alpha) N_t(z)^{-\alpha}}$$

where $P_t^{ho}(z)$ is the optimal price. As this is the same for all firms resetting prices in t, we can write

$$P_t^{ho} = \frac{\theta}{\theta - 1} \Psi_t$$

with average marginal cost function $\Psi_t = \frac{W_t}{(1-\alpha)N_t^{-\alpha}}$.

If, instead, price setting is à la Calvo, with price stickiness parameter θ_p, the objective is $V_t(z)$,

$$\max_{P_t(z)} V_t(z) = \sum_{k=0}^{\infty} \theta_p^k E_t \left\{ Q_{t,t+k} \Pi_{t+k}(z) \right\}$$

where $Q_{t,t+k} \equiv \beta E_t \left\{ \frac{C_t}{C_{t+1}} \frac{P_t}{P_{t+1}} \right\}$ is the household's discount factor and the linearized optimality condition can be shown to be:

$$p_t^{ho} = \mu^p + (1 - \beta\theta_p) \sum_{k=0}^{\infty} (\beta\theta_p)^k E_t \left\{ \psi_{t+k|t} \right\} \tag{15}$$

where $\psi_{t+k|t} = \log \Psi_{t+k|t}$ is the log marginal cost function in period $t + k$ of those firms that reset their price in period t and that have not reset the price between t and $t + k$ and where $\mu^p \equiv \log \frac{\theta}{\theta-1}$ is the optimal log price markup.

3.2.3 Aggregate prices

Next we relate firm specific marginal costs $\psi_{t+k|t}$ to average marginal costs in order to derive an aggregate inflation equation. Using the approximate production relationship $y_t = (1 - \alpha)n_t$, that will be derived below, we can write

$$\psi_{t+k|t} = \psi_{t+k} + \alpha(n_{t+k|t} - n_{t+k})$$

and because

$$y_{t+k|t} - y_{t+k} = (1 - \alpha)\left(n_{t+k|t} - n_{t+k}\right)$$

we get

$$\psi_{t+k|t} = \psi_{t+k} + \frac{\alpha}{(1-\alpha)}\left(y_{t+k|t} - y_{t+k}\right)$$

The term in brackets can be related to the relative price of the non-adjusting firm prices and average domestic prices (the derivation is presented in the appendix),

$$y_{t+k|t} - y_{t+k} = -\theta\left(p_t^{ho} - p_{t+k}^h\right)$$

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so we obtain

$$\psi_{t+k|t} = \psi_{t+k} + \frac{\alpha\theta}{(1-\alpha)}\left(p_t^{ho} - p_{t+k}^h\right)$$

From this, (15), and the evolution of the aggregate domestic price index,

$$p_t^h = \theta_p p_{t-1}^h + (1 - \theta_p)p_t^{ho}$$

the aggregate domestic price inflation equation

$$\pi_t^h = \beta E_t\left\{\pi_{t+1}^h\right\} - \lambda_p\left(\mu_t^p - \mu^p\right)$$

can be derived, with domestic inflation $\pi_t^h \equiv p_t^h - p_{t-1}^h$, average price markup $\mu_t^p \equiv p_t^h - \psi_t$ and $\lambda_p \equiv \frac{(1-\theta_p)(1-\beta\theta_p)}{\theta_p}\frac{1-\alpha}{1-\alpha+\alpha\theta}$.

3.3 Monetary Policy

Central bank behavior is described by the following Taylor-type rule

$$\widehat{1+i_t} = \rho_i\widehat{1+i_{t-1}} + \phi_\pi\pi_t^h + \phi_y\widehat{y}_t + \phi_w\pi_t^w + \varepsilon_t$$

with monetary policy shock ε_t that follows a white noise process. The reason for choosing the domestic inflation rate rather than the CPI-inflation is that in an open economy, the output dispersion due to staggered price setting is proportional to domestic prices rather than the CPI so that the implied inefficiency will be reduced when the central bank reacts to changes in π_t^h rather than in π_t. This rule abstracts, however, from any reactions to fluctuations in the exchange rate or the terms of trade. The reaction to wage inflation is motivated by the improved stabilization performance as highlighted by Erceg et al. (2000).

3.4 Symmetric Equilibrium

The conditions for a symmetric equilibrium are obtained by aggregating individual demand functions to an aggregate one and individual employments to an aggregate employment index allowing the determination of an aggregate approximate production function. Furthermore, the aggregate resource constraint determines the international investment position.

3.4.1 Aggregate demand

Defining aggregate output per household as

$$Y_t \equiv \left[(1-n)^{-\frac{1}{\theta}} \int_n^1 \left(\frac{Y_t(z)}{1-n} \right)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}}$$

we get an aggregate demand relationship by plugging in the aggregate good specific demand functions (3) (re-scaled to denote per household values):

$$Y_t = \left(\frac{P_t^h}{P_t} \right)^{-\rho} C_t^W$$

This implies that in a symmetric steady state with $C = C^*$ we have $Y = C$ so that around the steady state, the aggregate demand relationship is approximately

$$
\begin{aligned}
\widehat{y}_t &= \widehat{c}_t^W - \rho \left(\widehat{p}_t^h - \widehat{p}_t \right) \\
\widehat{y}_t &= \widehat{c}_t^W - \rho n \widehat{\tau}_t
\end{aligned}
\tag{16}
$$

Because for the foreign country the corresponding equation is

$$\widehat{y}_t^* = \widehat{c}_t^W + \rho (1-n) \widehat{\tau}_t$$

the difference between domestic and foreign output is proportional to the terms of trade:

$$\widehat{y}_t - \widehat{y}_t^* = -\rho \widehat{\tau}_t$$

A deterioration of the domestic terms of trade, i.e. $\overline{\tau}_t < 0$, results in a positive output differential vis-à-vis the foreign country so that an expansionary monetary policy shock that depreciates the domestic exchange rate reallocates production towards the domestic economy as it induces a consumption switching effect, the size of which is determined by the cross-country elasticity of substitution ρ.

3.4.2 Aggregate production and markups

Aggregation of labor input $N_t(i, z)$ over all firms and types results in the following aggregate labor input N_t:

$$
\begin{aligned}
N_t &= \int_n^1 \int_0^1 N_t(i, z) \, di \, dz \\
&= \int_n^1 N_t(z) \int_0^1 \frac{N_t(i, z)}{N_t(z)} \, di \, dz \\
&= \Delta_t^w \int_n^1 N_t(z) \, dz \\
&= \Delta_t^w Y_t^{\frac{1}{1-\alpha}} \int_n^1 \left(\frac{Y_t(z)}{Y_t} \right)^{\frac{1}{1-\alpha}} dz \\
&= \Delta_t^w \Delta_t^p Y_t^{\frac{1}{1-\alpha}}
\end{aligned}
$$

with $\Delta_t^w \equiv \int_0^1 \left(\frac{W_t(i)}{W_t} \right)^{-\epsilon_w} di$ and $\Delta_t^p \equiv \int_n^1 \left(\frac{Y_t(z)}{Y_t} \right)^{\frac{1}{1-\alpha}} dz$ denoting employment and output dispersion that are due to the wage and price rigidities.[9]

Galí (2010) showed that fluctuations of Δ_t^w are of second order, i.e. that up to a first order approximation this term is zero. The same is shown for Δ_t^p in the appendix so that we can derive the approximate aggregate production function

$$
y_t = (1 - \alpha) n_t
$$

The price markup is approximately

$$
\begin{aligned}
\widehat{\mu}_t^p &= p_t^h - \psi_t - \mu^p \\
&= p_t^h - w_t + \log(1 - \alpha) - \alpha n_t - \mu^p \\
&= (p_t^h - p_t) - (w_t - p_t) - \alpha n_t + \log(1 - \alpha) - \mu^p \\
&= n\tau_t - \omega_t - \alpha n_t + \log(1 - \alpha) - \mu^p
\end{aligned}
$$

Noting that $\log(1 - \alpha) - \mu^p$ equals $\omega_t + \alpha n_t$ in the steady state, we get

$$
\widehat{\mu}_t^p = n\widehat{\tau}_t - \widehat{\omega}_t - \frac{\alpha}{1 - \alpha} \widehat{y}_t
$$

For the wage mark-up we have accordingly

$$
\begin{aligned}
\widehat{\mu}_t^w &= \omega_t - \widehat{mrs}_t \\
&= \omega_t - \widehat{c}_t - \varkappa \widehat{u}_t - \varphi \widehat{n}_t
\end{aligned}
$$

---

[9]For the fourth equality note that the production function can be re-arranged to get $N_t(z) = Y_t(z)^{1/(1-\alpha)} = (Y_t(z)Y_t/Y_t)^{1/(1-\alpha)}$.

3.4.3 International Investment Position

The aggregate resource constraint determines the domestic economy's international investment position D_t, which follows from (5) and (14):

$$D_t = (1 + i_t)D_{t-1} + P_t^h Y_t - P_t C_t$$

In an initial steady state that is symmetric across countries with $D = 0$, we have $Y = C$, and accordingly for the foreign country $Y^* = C^*$. Setting $Y = Y^*$ and normalizing the initial price levels such that it equals one, around the steady state we have approximately[10]

$$\widehat{c}_t = -d_t + \beta^{-1}d_{t-1} + \widehat{y}_t + n\widehat{\tau}_t$$

3.4.4 Steady state

From the price and wage setting equations and the aggregate resource constraint $Y = C$ follows the steady state output and employment levels

$$Y = \left((1 - \alpha) \left(\frac{\theta}{\theta - 1} \right)^{-1} \overline{\varkappa}^{-1} \left(\frac{\epsilon_w}{\epsilon_w - 1} \right)^{-\left(1 + \frac{\varkappa}{\varphi}\right)} \right)^{\frac{1 - \alpha}{1 + \varphi}}$$

and

$$N = Y^{\frac{1}{1 - \alpha}}$$

The volumes of output and employment in the steady state are thus an inverse function of the degree of monopolistic distortion in the goods and the labor market and the concavity of the production function. Furthermore, the modification of the disutility of labor function ($\varkappa > 0$) reduces the steady state output and employment as an increase in unemployment increases the disutility from work implying a reduction in the supply of labor. The constant $\overline{\varkappa}^{-1}$ can offset this effect if parameterized accordingly. The steady state inefficiencies in the goods and labor markets and unemployment drive the welfare implications of monetary policy shocks as discussed below.

3.5 Calibration

The calibration follows mainly that of Engler and Tervala (2011) for the open economy variables and Galí (2010) for the domestic variables. β is set

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[10]Combing this equation with the corresponding foreign one, $\widehat{c}_t^* = \frac{1-n}{n}d_t - \beta^{-1}\frac{1-n}{n}d_{t-1} + \widehat{y}_t^* - (1-n)\widehat{\tau}_t$, one obtains the international aggregate resource constraint $(1 - n)\widehat{c}_t + n\widehat{c}_t^* = (1 - n)\widehat{y}_t + n\widehat{y}_t^*$.

to 0.99 implying a steady state annual interest rate of roughly 4 percent when regarding periods as quarters. For θ and α I choose a value of nine and 0.25, respectively, so that the steady state labor share, $\frac{W}{P}\frac{N}{Y} = (1 - \alpha)\left(\frac{\theta}{\theta-1}\right)^{-1}$, equals 67 percent and the markup 12.5 percent. The degree of price and wage rigidity, θ_p and θ_w, is 0.75 implying price and wage adjustments after four quarters on average. Setting the steady state unemployment rate to 5 percent and the Frisch elasticity, i.e. φ^{-1} to 0.2 implicitly determines the degree of the monopolistic distortion in the labor market (because $\mu^w = \varphi u$) for which $\epsilon_w = 4.52$ follows. ρ, the cross-country substitution elasticity, is set to values in the range of 0.5 and 6 as in Engler and Tervala (2011). The coefficients of the Taylor rule are $\rho_i = 0.9$, $\phi_\pi = 1.5$ and $\phi_y = \phi_w = 0.125$. The coefficient determining the risk premium, ψ, is set to 0.003, which is roughly in line with the value reported by Bergin (2006). $\overline{\varkappa}$ is chosen to exactly offset the effect of unemployment on steady state output, i.e. $\overline{\varkappa} = \left(\exp\left(u\right)^{\varkappa}\right)^{-1}$ in order to make the dynamics comparable to the benchmark model without the modification of the utility function. $\varkappa$ is set to 2.3 as this roughly allows the replication of the relative response of the labor force and the unemployment rate in response to the monetary policy shock as shown by CTW.

4   Monetary Policy Shocks

Figures 1-3 present the impulse responses to a negative shock to the central bank's target rate both for a model with (denoted as "w") the modified utility function and the benchmark without (denoted as "w/o") this modification, i.e. the standard New Keynesian model for three values of the cross-country substitutability ρ (3, 1 and 0.5 respectively). These positive dynamics are discussed in Section 4.1, first for the benchmark model and then for the model with the modified utility function.

The normative implications are discussed in Section 4.2, again first for the benchmark model and then for the model with modified utility. The welfare metrics employed are the change in period utility due to the shock and the discounted present value of these changes. Taking a first order Taylor expansion to the representative household's utility function, this utility change can be shown to be approximately[11]:

$$dV_t = \widehat{c}_t - \varkappa \frac{N^{1+\varphi}}{1+\varphi}\widehat{u}_t - N^{1+\varphi}\widehat{n}_t$$

---

[11]This approach has been followed by Ganelli and Tervala (2010) and Tervala (2010) and Engler and Tervala (2010).

This perspective thus tracks the effects of a shock on period-by-period utility allowing an assessment of the evolution of these effects over time. The new open economy macroeconomic literature in the tradition of Obstfeld and Rogoff (1995) employed a different, but closely related welfare metric, the discounted present value of the period utility changes,

$$
\begin{aligned}
dV_t^{DVP} &\equiv E_o \sum_{t=0}^{\infty} \beta^t dV_t\left(.\right) \\
&\equiv E_o \sum_{t=0}^{\infty} \beta^t \left(\widehat{c}_t - \varkappa \frac{N^{1+\varphi}}{1+\varphi} \widehat{u}_t - N^{1+\varphi} \widehat{n}_t \right)
\end{aligned}
$$

which describes the total effect of a shock on welfare. Both concepts are reasonable for policy analysis and they should be regarded as complements rather than substitutes as they highlight two important dimensions of welfare effects of policy shocks. Table 1 reports the welfare effects for the latter metric and the effects on period welfare on impact, i.e. dV_1 where $t = 1$ is the shock period.

4.1 Positive Analysis

4.1.1 The Benchmark model

The domestic monetary policy shock ceteris paribus pushes the domestic interest rate below its steady state value reducing the real rate of interest both domestically and abroad because domestic and foreign rates are linked through the uncovered interest parity condition and because goods prices are sticky. Aggregate demand *for both home and foreign firms* increases after the decrease of the real interest rates as households substitute tomorrow's for today's consumption. I denote this the *real interest rate effect* which is present also in closed economy settings. Firms hire more workers to meet this extra demand, they accomplish this by paying higher wages, boosting both wage inflation $\left(\pi_t^w\right)$ and domestic price inflation $\left(\pi_t^h\right)$ to the extent that this is possible, given the assumed price and wage rigidities. This, in turn, partially reverses the reduction of the interest rate as the central bank endogenously reacts to price and wage inflation.

A second effect works through the terms if trade. The change of the exchange rate can be seen when we log-linearize the uncovered interest rate condition, solve forward and note that $\widehat{s}_\infty = 0$. Then we get

$$
\widehat{s}_t = - \sum_{t=0}^{\infty} \left(\widehat{1 + i_{t+i}} - \widehat{1 + i_{t+i}^*} + \psi d_{t+i} \right)
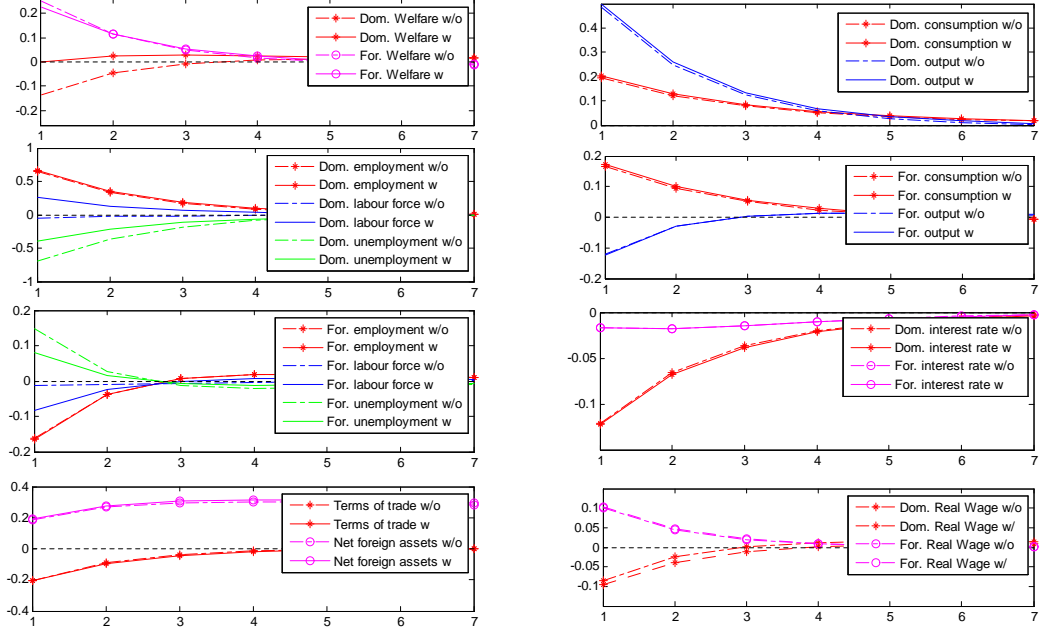$$

Figure 1: Monetary policy shock, $\rho = 3$

When the monetary policy shock induces a fall of the domestic interest rate below the foreign one for some time and/or improves the international investment position (i.e. $d_t > 0$), this tends to depreciate the nominal exchange rate. This is what happens in the present model. As goods prices are sticky, the terms of trade will deteriorate (in the present model this implies a decline in τ, i.e. $\widehat{\tau}_t < 0$; see equation (4)) and as long as domestic and foreign goods are (imperfect) substitutes, relative demand will shift away from foreign goods and towards domestic goods. This *expenditure switching effect* implies an increase in demand for domestic goods beyond the increase in domestic demand while the opposite occurs abroad.

From the expenditure switching effect two effects follow: First, the domestic disutility of labor effort further increases as employment increases. Exactly the opposite happens in the foreign economy where the employment increase due to the real interest rate effect is reversed. Second, firms' revenues increase relative to foreign firms' revenues when the Marshall-Lerner-Robinson condition is fulfilled, as this implies that the decline in the relative price of domestic firms (the terms of trade) is more than compensated by the increase in relative output. Tille (2001) showed that the Marshall-Lerner-Robinson condition is fulfilled for $\rho > 1$. There is thus an improvement
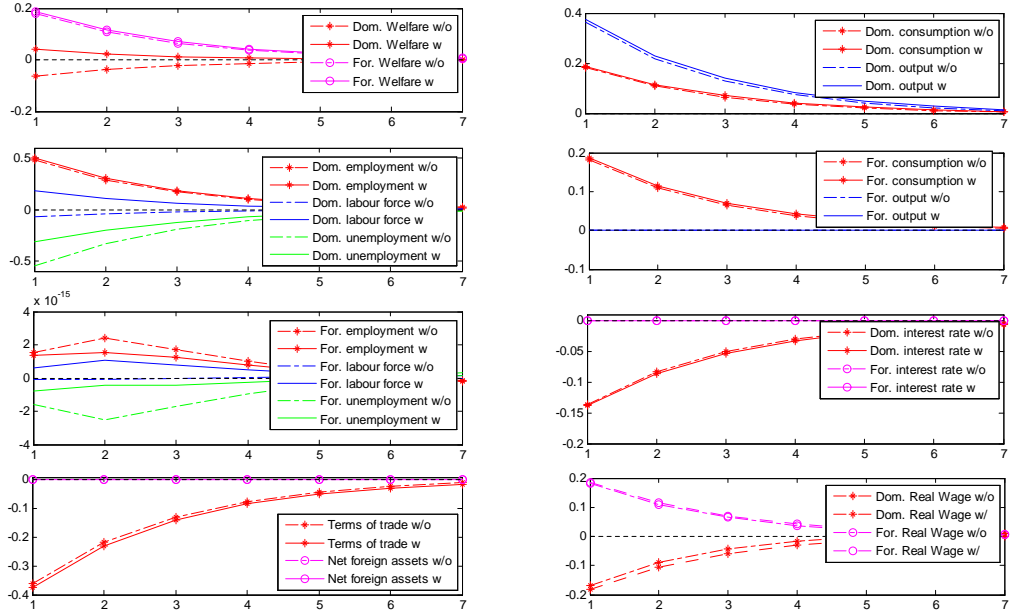
Figure 2: Monetary policy shock, $\rho = 1$

of the international investment position vis-à-vis the foreign economy (the current account effect) in that case, d_t increases. Households will smooth the additional consumption that the additional income affords. As a consequence, the short run relative increase in output and employment on the one hand and consumption on the other hand increases relative to the closed economy scenario. For $\rho > 1$, in contrast, the relative domestic revenues fall, deteriorating the international investment position ($d_t < 0$).

The changes in employment are achieved both through flows in and out of unemployment and through flows in and out of the labor force. Equation (10) determines the substitution of the marginal worker into a job while equation (9) determines entry and exit into and out of the labor market for the marginal worker who is indifferent between inactivity and joining the labor force. In the benchmark model where $\varkappa = 0$, a monetary policy shock increases consumption while affecting the real wage only slightly due to staggered wages and prices. This reduces the labor force because households prefer both more consumption and more leisure as both are normal goods. This is commonly referred to as the *wealth effect* in the literature. Employment, on the other hand, increases as the wage markup is suppressed. Unemployment falls because both effects work in the same direction.
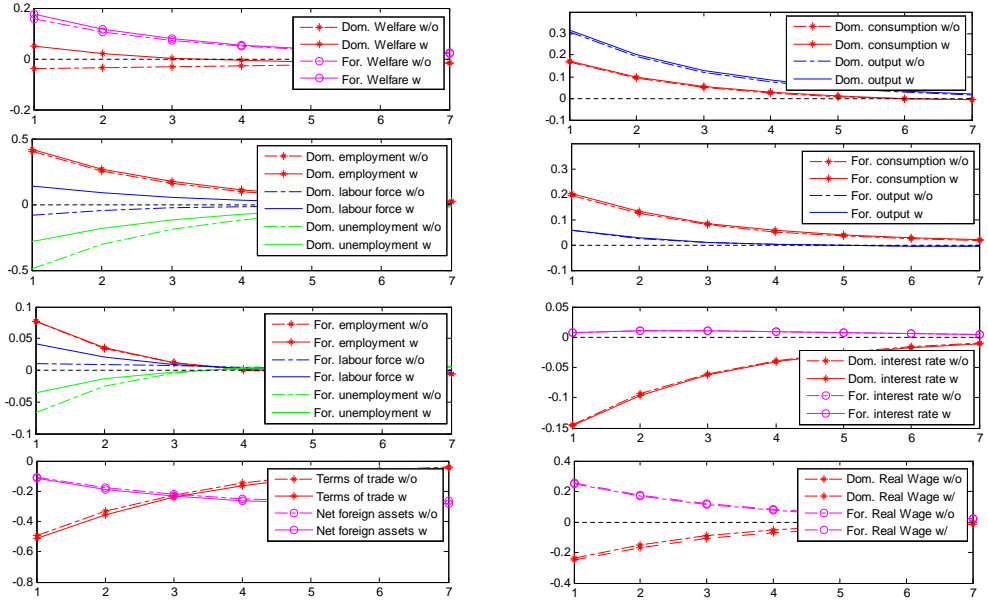
24

Figure 3: Monetary policy shock, $\rho = 0.5$

4.1.2 The Modified Utility Model

When the utility function is modified to take account of the feedback effect from aggregate unemployment on the disutility of labor, the labor market dynamics are significantly altered. In this case, the wealth effect no longer needs to be at play: The fall in the rate of unemployment reduces the disutility of labor and the marginal rate of substitution of the worker who is indifferent between participation and inactivity (equation 9). As a consequence, the labor force can increase if appropriately parameterized (i.e. $\varkappa$ being large enough) and the labor force and employment are positively correlated in response to monetary policy shocks. This is in stark contrast to the benchmark model in which the wealth effect implies the opposite sign of the labor supply change and which is at odds with the stylized fact presented by CTW.

The muted response of the marginal rate of substitution results in a reduced real wage compared to the benchmark model allowing for a bigger increase in employment as workers' perceived risk of losing their jobs falls. Output and consumption increase too, although all these effects are rather small. The net effect of the increase in employment and the increased labor force on the rate of unemployment depends on the relative size of the two effects. As the latter clearly dominates the first, unemployment falls less

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compared to the benchmark case. In the foreign economy the effect on output and consumption is hardly visible, while the labor supply and unemployment responses are muted.

Summing up, the modification of the utility function affects the response of the labor force and the rate of unemployment significantly while leaving employment and output relatively unaltered.

4.2 Normative Analysis

The normative implications of these impulse responses for both the benchmark model and the model with modified utility are illustrated by the welfare metrics mentioned above. The period utility changes for three parameterizations are displayed in the first graphs in Figures 1-3 while the first period changes and the discounted presented value (DPV) in welfare are displayed in Table 1.

	$\rho = 0.5$	$\rho = 1$	$\rho = 1.5$	$\rho = 3$	$\rho = 6$
$dV_1(w/o)$	-0.040	-0.065	-0.086	-0.133	-0.189
$dV_1(w)$	-0.051	-0.040	-0.029	-0.001	-0.032
$dV_1^*(w/o)$	0.156	0.181	0.202	0.249	0.305
$dV_1^*(w)$	0.176	0.186	0.198	0.226	0.260
$dV_t^{DPV}(w/o)$	-0.490	-0.148	-0.019	0.125	0.211
$dV_t^{DPV}(w)$	-0.311	-0.079	0.227	0.396	0.498
$dV_t^{*DPV}(w/o)$	0.754	0.412	0.283	0.138	0.052
$dV_t^{DPV}(w)$	0.837	0.447	0.299	0.129	0.027

Table 1: Welfare effects of monetary policy shocks

4.2.1 The Benchmark Model

Engler and Tervala (2011) show that even for a scenario in which the Marshall-Lerner-Robinson condition is not fulfilled, the *short-run* welfare effect of an expansionary monetary policy shock is negative. i.e. that the increase in disutility from labor is larger than the increase in consumption utility. This

means than irrespective of the size of the substitution elasticity between domestically and foreign produced goods, an expansionary monetary policy is beggar-thyself in the short-run.

The short-run beggar-thyself effect can be seen in Table 1, where domestic welfare falls immediately after the shock while foreign welfare increases. The increase in domestic employment is larger than the increase in consumption while foreign employment falls. The net effect on domestic welfare is negative, even though the coefficient on the first, $N^{1+\varphi}$, is roughly 0.5, weakening the impact of the increase in employment significantly. The welfare effect for the foreign economy is clearly positive as consumption increases and employment falls. The expenditure-switching effect thus has a powerful implication for short-run welfare in open economies.

In the long run these effects can change, however. In case of a permanent wealth reallocation in favor of the domestic economy which occurs for $\rho > 1$, as is the case in the models of Obstfeld and Rogoff (1995) and Engler and Tervala (2011) which possess the random walk property discussed above, households can afford a higher level of consumption and a lower level of hours as they receive a permanent stream of interest payments from the foreign country in the new steady state. Monetary policy is beggar-thy-neighbor in the long run in these models.

Here, however, the long-run equilibrium is the same steady state as the old one, so that we can only look at the "medium run", the time between the quarters immediately after the shock and the new/old steady state. In the case of an initial improvement of the international investment position when $\rho > 1$, domestic welfare turns positive in the medium-run because households smooth the reduction of consumption towards the steady state while employment falls (although this effect is hardly visible in the graph for small values of ρ). They accomplish this by driving down their international investment position that they had built up in the first quarters after the shock. The foreign country pays back its debt by reducing consumption below and increasing employment and the labor force above the steady state levels. When $\rho < 1$, the international investment position falls initially and the domestic economy needs to keep consumption low enough to repay this debt thereby keeping the sign of the effect on welfare negative in the medium-run.

Consequently, monetary policy shocks are beggar-thy-neighbor in the medium-run in the benchmark model for $\rho > 1$ and beggar-thyself for $\rho < 1$. The discounted present values of these period utility changes can be read off the bottom part of Table 1. For $\rho < 1$ both the short-run and the medium-run effects are negative so that the overall welfare effect is negative. Increasing the value of ρ increases the initial negative impact as the expendi-

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ture switching effect increases employment, but it also increases the current account effect which improves the impact in the medium term. The second effect clearly dominates the first effect and net impact on the discounted present value is such that welfare improves in ρ.

The foreign economy gains in terms of welfare, both in the short-run and in terms of the discounted present discounted value and for all values of ρ.

4.2.2 The Modified Utility Model

As discussed above, the modification of the utility function has a large effect on the response of the domestic unemployment rate (and the labor force) to the monetary policy shock while the responses of consumption and employment change a lot less. However, the unemployment rate falls in a significant order of magnitude in any case. Consequently, the welfare effects are pushed up in all specifications as the lower unemployment rate reduces the negative effect on utility of the increase in employment. The short-run beggar-thyself effect does not vanish but falls while welfare in terms of the discounted present value turns positive for smaller values of the cross-country substitutability ρ than in the benchmark model. Most notably, the increase in welfare is significant for all specifications.

Summing up, taking account of a feedback effect of unemployment on the disutility of labor alters the welfare impact of an expansionary monetary policy shock in an open economy (and, of course, in a closed economy as well) as the effect on welfare by the large increase in employment due to the real interest rate effect and the expenditure switching effect relative to the increase in consumption is muted. The range of values of the cross-country substitutability for which overall welfare actually increases, i.e. where a beggar-thyself effect is avoided, is enlarged.

4.3 Robustness Analysis

As the strict link between unemployment and employment and thereby unemployment and output falls when the preference shifter is included, a natural question that arises is if it makes a difference whether output or unemployment is targeted by the central bank's Taylor rule. And indeed, after the expansionary monetary policy shock, unemployment falls less than output increases when the shifter is included. Consequently, the reduction of the interest rate and the terms of trade is larger and the increase in output bigger if unemployment is included in the Taylor rule instead of output (with opposite sign).[12]

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[12]Results are available upon request.

5 Conclusions

My main finding is that taking account of effects of unemployment on workers well-being who are not unemployment themselves, which is motivated by the findings of Lüchinger, Meier and Stutzer (2010), improves the empirical fit of the New Keynesian model in an important dimension. The counter factual wealth effect in response to monetary policy shocks is shut down: The labor force grows after an expansionary monetary policy shock in line with the empirical finding of Christiano, Trabandt and Walentin (2010). Furthermore, the welfare implications of such shocks are considerably changed in that an expansionary shock has a much more beneficial effect on welfare because the fall of the unemployment rate increases employed workers' utility.

A drawback of the present model is certainly the risk sharing within families. Unemployment does not change consumption relative to employed family members but improves relative utility as the disutility of work is zero. However, improving the model in this respect would make the argument made here even stronger as the negative welfare effects of unemployment would increase. The negative welfare effects of the present analyses can thus be regarded as a lower bound of such effects.

The present framework allows explorations into a few other important directions which are subject of related research. First, the model allows for different spillover effects of monetary policy shocks on other country's unemployment. Depending on the parameterization of the cross-country elasticity of substitution, the foreign unemployment rate can fall or increase. Policy makers are often concerned about expansionary interest rate decisions in the United States on their own country's unemployment rate and usually point to adverse expenditure switching and beggar-thy-neighbour effects. In a related paper I shed light on this question in an empirical analysis for G7 countries employing vector autoregressions.

Second, the optimal endogenous response of central banks to various shocks may be considerably altered when unemployment affects welfare. In particular, the optimal reaction to a an increase in unemployment is likely to be a lot more aggressive than in standard models.

Third, modern welfare states imply considerable fiscal costs of unemployment. Between 1991 and 2010 the annual German social security expenditures ("Sozialversicherungsausgaben") and the unemployment rate had a correlation coefficient of 0.67. These expenditures are usually associated with distortionary taxes and social security contributions. These distortions increase with unemployment causing a considerable burden for society. Taking account of such effects might change the optimal policy mix in response to an increase in unemployment.

References

[1] Bergin, Paul R. (2006): How well can the New Open Economy Macro-economics explain the exchange rate and current account? *Journal of International Money and Finance*, 25, 675-701.

[2] Blanchard, Olivier J. and Nobuhiro Kiyotaki (1987): Monopolistic Competition and the Effects of Aggregate Demand. *American Economic Review*, 77, No. 4 (September), 647-666.

[3] Bluedorn, John C. and Christopher Bowdler (2011): The Open Economy Consequences of U.S. Monetary Policy. *Journal of International Money and Finance*, 30, 309–336.

[4] Calvo, Guillermo (1983): Staggered Prices in a Utility Maximizing Framework. *Journal of Monetary Economics,* 12, 383-398.

[5] Christiano, Lawrence J., Mathias Trabandt and Karl Walentin (2010): Involuntary Unemployment and the Business Cycle, mimeo.

[6] Clark, Andrew E. and Andrew J. Oswald (1994): Unhappiness and Unemployment. *The Economic Journal*, 04, No. 424 (May), 648-659.

[7] Corsetti, Giancarlo and Paolo Pesenti (2001): Welfare and Macroeconomic Interdependence. *Quarterly Journal of Economics*, 116, 421-455.

[8] Dekker, Sidney W.A. and Wilmar B. Schaufeli (1995): The Effects of Job Insecurity on Psychological Health and Withdrawal: A Longitudinal Study. *Australian Psychologist*, 30, No.1, 57–63.

[9] De Witte, Hans (1999): Job Insecurity and Psychological Well-Being: Review of the Literature and Exploration of Some Unresolved Issues, *European Journal of Work and Organizational Psychology*, 8, No.2, 155-177.

[10] Engler, Philipp and Juha Tervala (2011): Beggar-Thyself or Beggar-Thy-Neighbour? The Welfare Effects of Monetary Policy, *Economic Modelling*, 28, 2034–2040.

[11] Erceg, Christopher J., Dale W. Henderson and Andrew T. Levin (2000): Optimal Monetary Policy with Staggered Wage and Price Contracts. *Journal of Monetary Economics*, 46, No. 2, 281-314.

[12] Galí, Jordi (2010): Unemployment Fluctuations and Stabilization Policies: A New Keynesian Perspective. mimeo.

[13] Galí, Jordi (2011): The Return of the Wage Phillips Curve, *Journal of the European Economic Association*, 9, No.3, 436-461.

[14] Galí, Jordi, Frank Smets and Raf Wouters (2011): Unemployment in an Estimated New Keynesian Model, NBER Working Paper No. 17084.

[15] Ganelli, Giovanni and Juha Tervala (2010): Public Infrastructures, Public Consumption, and Welfare in a New-Open-Economy-Macro Model, *Journal of Macroeconomics*, 32, No. 3, 827-837.

[16] Hansen, Gary D. (1985): Indivisible labor and the business cycle. *Journal of Monetary Economics*, 16, No. 3 (November), 309-327.

[17] Huang, Kevin X.D. and Zheng Liu (2007): Business cycles with staggered prices and international trade in intermediate inputs, *Journal of Monetary Economics*, 54, No. 4 (May), 1271-1289.

[18] Jaimovich, Nir and Sergio Rebelo (2009): Can News about the Future Drive the Business Cycle? *American Economic Review*, 99, No.4, 1097-1118.

[19] Jones, Fiona and Ben Fletcher (1993): An Empirical Study of Occupational Stress Transmission in Working Couples, *Human Relations*, 46, No.7, 881-903.

[20] Lüchinger, Simon, Stephan Meier and Alois Stutzer (2010): Why Does Unemployment Hurt the Employed? *The Journal of Human Resources*, 45, No.4, 998-1045.

[21] McKee, Lorna and Colin Bell (1986): His Unemployment, Her Problem: the Domestic and Marital Consequence of Male Unemployment, *The Experience of Unemployment*, Sheila Allen, Alan Waton, Kate Purcell and Stephen Wood (Eds.), Macmillan Press, London.

[22] Merkl, Christian and Dennis Wesselbaum (2011): Extensive versus intensive margin in Germany and the United States: any differences? *Applied Economics Letters*, 18, No.9, 805-808.

[23] Obstfeld, Maurice and Kenneth Rogoff (1995): Exchange Rate Dynamics Redux. *Journal of Political Economy*, 103, No. 3.

[24] Oswald, Andrew J. (2003): How much do external factors affect well-being? A way to use 'happiness economics' to decide. *Psychologist*, 16, No.3, 140-141.

[25] Phillips, Alban W. H. (1958): The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957, *Economica*, 25, 283-299.

[26] Schmitt-Grohé, Stephanie and Martin Uribe (2003): Closing Open Economy Models. *Journal of International Economics*, 61, 163–185.

[27] Tervala, Juha (2010): The International Transmission of Monetary Policy in a Dollar Pricing Model. *Open Economies Review*, 21, No.5, 629-654.

[28] Tille, Cédric (2001): The Role of Consumption Substitutability in the International Transmission of Monetary Shocks. *Journal of International Economics*, 53, 421-444.

A   Appendix

A.1   Fluctuations of Δ_t^p around the symmetric steady state of order 1 are zero.

We need to show that a first order Taylor approximation of Δ_t^p around a symmetric steady state is zero. Up to first order, we have

$$\left(\frac{Y_t(z)}{Y_t}\right)^{\frac{1}{1-\alpha}} - \left(\frac{Y(z)}{Y}\right)^{\frac{1}{1-\alpha}} = \frac{1}{1-\alpha}\left(\frac{Y(z)}{Y}\right)^{\frac{1}{1-\alpha}-1}\left(\frac{1}{Y}dY_t(z) - \frac{Y(z)}{Y^2}dY_t\right)$$

$$\widehat{\left(\frac{Y_t(z)}{Y_t}\right)^{\frac{1}{1-\alpha}}} = \frac{1}{1-\alpha}\left(\widehat{y}_t(z) - \widehat{y}_t\right)$$

and after integrating over all z we have

$$\int_n^1 \widehat{\left(\frac{Y_t(z)}{Y_t}\right)^{\frac{1}{1-\alpha}}} dz = \frac{1}{1-\alpha}\left(\int_n^1 \widehat{y}_t(z)dz - \widehat{y}_t\right)$$

So we need to show that $\int_n^1 \widehat{y}_t(z)dz = \widehat{y}_t$. In order to derive this equality we assume an index for per household consumption Y_t of the form, $Y_t = \left[(1-n)^{-\frac{1}{\theta}}\int_n^1\left(\frac{Y_t(z)}{1-n}\right)^{\frac{\theta-1}{\theta}}dz\right]^{\frac{\theta}{\theta-1}}$, which in the steady state reduces to

$$Y = \left[(1-n)^{-\frac{1}{\theta}}\int_n^1\left(\frac{Y(z)}{1-n}\right)^{\frac{\theta-1}{\theta}}dz\right]^{\frac{\theta}{\theta-1}}$$

$$= \frac{1}{1-n}\left[(1-n)^{-\frac{1}{\theta}}Y(z)^{\frac{\theta-1}{\theta}}\int_n^1 dz\right]^{\frac{\theta}{\theta-1}}$$

$$= Y(z)$$

This convenient equality between the level of output at the firm level $Y(z)$ and aggregate per-capita output Y follows because the size of the economy measured in terms of the number of firms equals the size of the economy measured in terms of households. As a consequence, aggregation over all firms and normalization by households exactly cancel. Around this steady

state we have

$$Y_t = \left[(1-n)^{-\frac{1}{\theta}} \int_n^1 \left(\frac{Y_t(z)}{1-n} \right)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}}$$

$$Y_t - Y \approx \frac{1}{1-n} \frac{\theta}{\theta-1} \underbrace{\left[(1-n)^{1-\frac{1}{\theta}} Y^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}-1} (1-n)^{-\frac{1}{\theta}}}_{Y^{\frac{1}{\theta}}}$$

$$* (1-n) \frac{\theta-1}{\theta} Y(z)^{-\frac{1}{\theta}} \int_n^1 \left(Y_t(z) - Y(z) \right) dz$$

$$\widehat{y}_t \approx \int_n^1 \widehat{y}_t(z) dz \qquad (17)$$

This verifies the claim stated above.

A.2 $\quad y_{t+k|t} - y_{t+k} = -\theta \left(p_t^{ho} - p_{t+k}^h \right)$

First we approximate the demand function of firm z:

$$Y_{t+k|t}^d(z) = \left(\frac{P_t^{ho}(z)}{P_{t+k|t}^h} \right)^{-\theta} \left(\frac{P_{t+k}^h}{P_{t+k}} \right)^{-\rho} C_{t+k}^W$$

$$\widehat{y}_{t+k|t}(z) \approx -\theta \left(p_t^{ho}(z) - p_{t+k}^h \right) - \rho \left(p_{t+k}^h - p_{t+k} \right) + \widehat{c}_{t+k}^W$$

Subtracting (17) and plugging $\widehat{y}_{t+k|t}(z)$ into $\widehat{y}_{t+k}$, we get

$$\widehat{y}_{t+k|t}(z) - \widehat{y}_{t+k} \approx -\theta \left(p_t^{ho}(z) - p_{t+k}^h \right) - \rho \left(p_{t+k}^h - p_{t+k} \right) + \widehat{c}_{t+k}^W$$

$$- \int_n^1 \left(-\theta \left(p_{t+k}^h(z) - p_{t+k}^h \right) - \rho \left(p_{t+k}^h - p_{t+k} \right) + \widehat{c}_{t+k}^W \right) dz$$

$$= -\theta p_t^{ho}(z) + \int_n^1 \theta p_{t+k}^h(z) dz$$

Noting that

$$P_{t+k}^h \equiv \left((1-n)^{-1} \int_n^1 \left(P_{t+k}^h(z) \right)^{1-\theta} dz \right)^{\frac{1}{1-\theta}}$$

can be approximated by

$$\widehat{p}_{t+k}^h \approx \int_n^1 \widehat{p}_{t+k}^h(z)dz$$

we get

$$\widehat{y}_{t+k|t}(z) - \widehat{y}_{t+k} = -\theta\left(\widehat{p}_t^h(z) - \widehat{p}_{t+k}^h\right)$$

As this relation is valid for all firms having re-set their price in t and because the the steady state $y(z) = y$ and $p^h(z) = p^h$ we can write

$$y_{t+k|t} - y_{t+k} = -\theta\left(p_t^{ho} - p_{t+k}^h\right)$$